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8 shows one of these caps, *q*, on its place; *r r*, fig. 1, a shelf fixed to the mercurial trough, to hold the lamps; *s s* the graduated jar. Tin pipes with corks, *w w*, as shown in fig. 2, are the apertures to pour the spirit into the lamps; their places only are marked at *w w*, fig. 1.

N° IV.

HYDROMETER FOR SALINE SOLUTIONS.

The GOLD VULCAN MEDAL was this Session presented to Mr. J. T. COOPER, of Paradise Street, Lambeth, for a HYDROMETER FOR SALINE SOLUTIONS. The following Communication has been received from Mr. C. on the Subject, and a Set of the Apparatus has been placed in the Society's Repository.

THE inconvenience and inaccuracy attending the hydrometers that have hitherto been in use for determining the specific gravity of acids, acid and alkaline solutions, solutions of neutral salts, &c. has caused me to direct my attention to the construction of an instrument that should be free from those objections; accordingly, it is presumed the instrument now presented to the public through the medium of the Society's transactions will be found convenient in its application, and accurate in its results.

In the present communication I shall venture to give those

instructions that will enable any one who is the least conversant with matters of this kind, to construct these instruments; and I do it the more especially as I am not acquainted with any work that treats of this subject in a way intelligible to ordinary understandings.

If the tube which forms the stem of the hydrometer be perfectly cylindrical (and choice should be made of such only as are so), the whole graduation from water to oil of vitriol may be effected by two solutions only, of intermediate specific gravity; it will be found convenient if these are of the specific gravity 1,3 and 1,6.

The internal bore of the tube should be of such a size as to admit of a paper scale being introduced, of the width of that shown in fig. 9, plate II, and the substance of the glass as thin as may be; the length of it may be about seven inches; upon this tube is to be blown, as in common, a glass bulb and stem, of the shape and about the proportional size, as is shown in fig. 8. It is also necessary to be provided with a considerable number of glass bulbs, with platina loops cemented into them, as is shown in the same plate; these must vary considerably in their weights, in order that one may be chosen from among them near the weight that is wanted. These things are all to be obtained of those persons who are in the habit of blowing glass for such purposes.

These things being prepared, the next step is, to proceed to graduate the hydrometer.

It is a well-known law in hydrostatics that when a solid body floats, partly immersed in a fluid, it displaces its own weight of that fluid; and it follows, as a necessary consequence, that the portion of the solid immersed is inversely as the density of the fluid in which it floats. Now, to apply this principle to the graduation of a hydrometer, say, as the

specific gravity of any fluid is to the specific gravity of water, so is the bulk of the immersed portion of a hydrometer, when floating in water, to that of the immersed portion of the same hydrometer when floating in the fluid the specific gravity of which forms the first term. Now the specific gravity of water, and also the bulk of the immersed portion of a hydrometer floating in it, being both considered as unity, the rule given above may be conveniently expressed as follows:—divide unity by the specific gravity, and the quotient will be the bulk of that portion of the instrument that is immersed.

The following Table has been constructed on this principle, and from it the scale given in plate III, has been formed, which is applicable to the graduation of any hydrometer whatever within the range of specific gravities expressed by it:—

A Table of Volumes corresponding to Specific Gravities.

S. G.	Volume.	S. G.	Volume.	S. G.	Volume.	S. G.	Volume.
,7	1,4285	1,	1,	1,3	,7692	1,6	,6250
,71	1,4084	1,01	,9900	1,31	,7633	1,61	,6211
,72	1,3888	1,02	,9803	1,32	,7575	1,62	,6172
,73	1,3698	1,03	,9708	1,33	,7511	1,63	,6134
,74	1,3513	1,04	,9615	1,34	,7463	1,64	,6097
,75	1,3333	1,05	,9523	1,35	,7407	1,65	,6060
,76	1,3157	1,06	,9434	1,36	,7352	1,66	,6024
,77	1,2987	1,07	,9345	1,37	,7299	1,67	,5988
,78	1,2820	1,08	,9259	1,38	,7246	1,68	,5952
,79	1,2658	1,09	,9174	1,39	,7194	1,69	,5917
,8	1,2500	1,1	,9090	1,4	,7142	1,7	,5882
,81	1,2345	1,11	,9009	1,41	,7092	1,71	,5847
,82	1,2195	1,12	,8928	1,42	,7042	1,72	,5813
,83	1,2048	1,13	,8849	1,43	,6993	1,73	,5780
,84	1,1904	1,14	,8771	1,44	,6944	1,74	,5747
,85	1,1764	1,15	,8695	1,45	,6896	1,75	,5714
,86	1,1627	1,16	,8620	1,46	,6849	1,76	,5681
,87	1,1379	1,17	,8547	1,47	,6802	1,77	,5649
,88	1,1363	1,18	,8474	1,48	,6756	1,78	,5617
,89	1,1235	1,19	,8403	1,49	,6711	1,79	,5585
,9	1,1111	1,2	,8333	1,5	,6666	1,8	,5555
,91	1,0989	1,21	,8264	1,51	,6622	1,81	,5524
,92	1,0869	1,22	,8196	1,52	,6578	1,82	,5494
,93	1,0752	1,23	,8130	1,53	,6535	1,83	,5464
,94	1,0638	1,24	,8064	1,54	,6493	1,84	,5434
,95	1,0526	1,25	,8000	1,55	,6452	1,85	,5405
,96	1,0416	1,26	,7936	1,56	,6410	1,86	,5376
,97	1,0309	1,27	,7874	1,57	,6305	1,87	,5342
,98	1,0204	1,28	,7812	1,58	,6329	1,88	,5319
,99	1,0101	1,29	,7751	1,59	,6289	1,89	,5291

To apply this scale—suppose it has been ascertained that from the point to which the instrument sinks in distilled water of a given temperature, to the point to which it sinks in a fluid whose specific gravity is 1,3, and of the same temperature, measures five inches, or any other quantity; take

this quantity in a pair of compasses, and having set one leg on the point marked 1, plate III, place the other on the vertical line drawn from the point marked 1, 3; then, by drawing a line between these two points, all the intermediate divisions will be found at the points where the verticals intersect this line. Next, take a heavier weight, and such as will sink the hydrometer in a fluid whose specific gravity is 1,3, nearly to the top of the scale; then transfer it into a solution whose specific gravity is 1,6; take off by the compasses the distance between those two points, and transfer it to the scale, as before. Lastly, take a heavier weight, that will sink the instrument, as before, in the fluid whose specific gravity is 1,6, to somewhere near the top of the scale; then plunge it into sulphuric acid whose specific gravity is 1,845, and mark this distance, and apply it to the scale, as before; thus all the intermediate divisions between water and oil of vitriol will have been obtained with accuracy to the second place of decimals, and these may now be transferred to the proper scale, as represented in plate II, fig. 9, ready for insertion into the tube of the hydrometer, which when done and fixed in its proper place the extremity of the tube may be sealed hermetically with the blow-pipe; but care must be taken to seal it by the impulse of the flame only, and not by allowing anything to touch it, otherwise the weight of the instrument might be changed, and its accuracy, consequently, be affected throughout its whole range.

I find it convenient to introduce into the tube while I am determining the distance between the points, a temporary scale, divided into minute arbitrary divisions, made of the same size and of the same paper as the one I intend for the real scale, by which I avoid any risk of error in measuring the divisions, and of ultimately effecting a change in the whole weight of the hydrometer.

It is almost needless to mention, that the same plan of construction may be extended to a hydrometer for fluids lighter than water; such an instrument may be advantageously employed for determining the specific gravity of ammoniacal solutions, of sulphuric æther, &c. and will be found to give results sufficiently near for commercial purposes, if temperature be correctly taken into the account; but for alcohol I cannot do better than recommend the use of Stokes's Hydrometer, as improved by Mr. Ainger.

The above method, as has been premised, depends upon the stem of the instrument being truly cylindrical; but should the stem be otherwise, a greater number of points must of consequence be taken, and, of course, a greater number of fluids will be required; not less than seventeen ought to be used under these circumstances; the interpolations may then be made as above.

N° V.

OXY-HYDROGEN BLOW-PIPE.

The GOLD ISIS MEDAL of the Society was this Session presented to GOLDSWORTHY GURNEY, Esq. Surgeon, for his OXY-HYDROGEN BLOW-PIPE, which has been placed in the Society's Repository.

THE investigations and discoveries of sir H. Davy, on the nature of flame, and the successful application of them in